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ORTH CENTRAL FOREST EXPERIMENT STATION, FOREST SERVICE—U.S. DEPARTMENT OF AGRICULTURE

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CONTROLLING HAZEL, ASPEN SUCKERS, AND MOUNTAIN MAPLE WITH PICLORAM

ABSTRACT. — Tests showed that picloram/2,4-D mixture was equal or superior to 2,4-D alone or a 2,4,5-D/2,4,5-T mixture in controlling hazel, aspen suckers, and mountain maple for reforestation purposes. Survival of red pine planted 9 months after treatment was not influenced by residual soil effects of picloram. However, foliar application contributed to mortality of established red pine.

OXFORD: 414.13+414.9+441. KEY WORDS: Site preparation, plantation release, red pine, forest weeds.

Hazel (*Corylus cornuta* Marsh. and *C. americana* Walt.) is one of the most abundant upland shrubs in Minnesota. It grows aggressively in nearly every upland timber type in the State, often in almost pure stands or as a dense understory. Aspen (*Populus tremuloides* Michx.) is also widely distributed and usually suckers profusely following logging, fire, shearing, or other disturbances that eliminate the parent trees and open the stand. Mountain maple (*Acer spicatum* Lam.) is found in the northeastern third of Minnesota. It grows primarily in scattered clumps, but on the Superior National Forest, especially near Lake Superior, it may form a continuous shrub canopy.

These species are obstacles to forest land managers wishing to convert brushy sites to conifers. They may be top-killed by foliar spraying with the common herbicides 2,4-D and 2,4,5-T, but resprouting from the roots is often vigorous.[1]. Excessive resprouting must be controlled before site preparation or conifer release can succeed. Picloram,[2] a recently developed herbicide, shows promise in reducing resprouting. However, picloram may remain active in the soil for many months following treatment[3] and it is phytotoxic to conifers.[4]

Two studies were made to find picloram dosages and the vegetative growth stage when treatments would provide adequate crown kill and reduce resprouting of brush species without seriously damaging planted conifers. The picloram formulation chosen for study was Tordon 101 Mixture,[5] which can be applied as a foliar spray. Either 2,4-D or a combination of 2,4-D and 2,4,5-T was used for comparison with Tordon 101.

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[1] *Sutton, R. F. Chemical herbicides and their uses in the silviculture of forests of eastern Canada. Canada, Dep. Northern Aff. & Nat. Resources, Forest. Br., Forest Res. Div., Tech. Note 68, 54 p. 1958.*

[2] *4-amino-3,5,6-trichloropicolinic acid.*

[3] *Hemphill, D. D. Performance of vegetable crops on an area treated with Tordon herbicide. Down-to-Earth 24(1): 2, 24. 1968.*

[4] *Kozlowski, T. T., Sasaki, S., and Torrie, J. H. Effects of temperature on phytotoxicity of monuron, picloram, CDEC, EPTC, CDAA, and sesone to young pine seedlings. Silva Fenn. 1(3): 13-28. 1967.*

[5] *Registered trade name of The Dow Chemical Company. Midland, Michigan. Contains 0.54 pounds picloram and 2 pounds 2,4-dichlorophenoxyacetic acid per gallon as the triisopropanolamine salts. Mention of trade names does not constitute endorsement by the USDA Forest Service.*

THE STUDIES

Two methods of herbicide application were tested in separate studies on the Chippewa National Forest. The first was a site preparation test using a back-pack mist blower in a relatively pure hazel stand during the first week of August 1966.[6] Five treatments were replicated three times on 1/10-acre compartments in a completely randomized design (table 1). In May 1967, 9 months after spraying, 100 2-1 red pine (*Pinus resinosa* Ait.) seedlings were planted in each compartment. Two milacre plots per compartment were examined 1 and 2 years after spraying and all hazel stems were classified as either dead, alive, or new sprouts. Two-year survival of the red pine was determined in November 1968. Seedlings were then classified as alive/healthy, alive/herbicide-damaged, or dead.

Table 1. — *Summary of chemical treatments applied to hazel by mist blower on August 2, 1966; the hazel averaged 84,000 stems per acre and 3.5 feet in height*

Chemical 1/	Rate of application			Total volume (chemical + water)	Stem survival	Stem resprouting after 2 years
	Picloram	2,4-D	2,4,5-T			
	Pounds ae/acre	Pounds ae/acre	Pounds ae/acre	Gal./acre	Percent of original	Percent of original
Tordon 101	0.5	2	--	5	0	3
Tordon 101	.5	2	--	10	1	7
Tordon 101	1.5	6	--	5	0	1
Tordon 101	1.5	6	--	10	0	12
2,4-D/2,4,5-T 2/	--	2	2	5	1	26

1/ All chemicals supplied by the Dow Chemical Co., Midland, Michigan.

2/ Low volatile iso-octyl esters of 2,4-dichlorophenoxyacetic acid and 2,4,5-trichlorophenoxyacetic acid with 4 pounds acid equivalent per gallon.

The impressive results of the mist blower study suggested that lower rates of Tordon 101 might be nearly as successful for hazel, and possibly other species, with aerial spraying. Furthermore, low rates might be tolerated by red pine, especially if spraying was done at a late growth stage when the pine needles were more mature. Therefore, the second treatment was a combined brush control and planted-tree release using simulated aerial spraying techniques developed by Roe.[7] A framed polyethylene enclosure was erected over square milacre plots to minimize drift of herbicides, which were applied as closely controlled aerosol mixtures with pressure provided by a portable compressed-air canister.

In 1968, five randomly assigned treatments at two growth stages (August 1 and August 20) were replicated four times in a hazel stand adjacent to the mist-blower experiment, and eight times for aspen suckers and red pine in a 2-year-old plantation prepared by shearing (table 2). Four randomly assigned treatments at the August 1 growth stage only were replicated five times for mountain maple in 1969. All treatments were evaluated 1 year later by measuring stem height (by 1-foot classes), estimating amount of live crown (to the nearest 10 percent), and counting the number of new sprouts.

Table 2. — *Summary of chemical treatments applied by simulated aerial spraying techniques on August 1 and August 20; all treatments were in water solution at a total volume of water plus chemical of 4 gallons per acre; hazel, aspen suckers, and mountain maple averaged 59,000, 26,000 and 18,000 stems per acre and 2.9, 3.5, and 4.6 feet in height, respectively. Evaluations were made 1 year after spraying*

Chemical 1/	Application		Hazel		Aspen		Mountain maple
	Picloram	2,4-D	Aug. 1	Aug. 20	Aug. 1	Aug. 20	Aug. 1
	Pounds ae/acre	Pounds ae/acre					
SURVIVAL (IN PERCENT OF TOTAL STEM LENGTH)							
Tordon 101	0.05	0.2	34	57	94	94	--
Tordon 101	.10	.4	1	15	76	82	43
Tordon 101	.20	.8	1	17	21	56	25
Tordon 101	.40	1.6	2	9	3	23	10
2,4-D 2/	--	2.0	1	18	50	64	51
RESPROUTING (IN PERCENT OF ORIGINAL NUMBER OF STEMS)							
Tordon 101	.05	.2	36	34	0	0	--
Tordon 101	.10	.4	18	33	2	0	1
Tordon 101	.20	.8	26	9	1	0	6
Tordon 101	.40	1.6	13	23	1	2	2
2,4-D 2/	--	2.0	9	20	2	0	12

1/ All chemicals supplied by The Dow Chemical Company, Midland, Michigan.

2/ Dimethylamine salt of 2,4-dichlorophenoxyacetic acid with 4 pounds acid equivalent per gallon.

The red pine trees (one was enclosed in each treated aspen plot) were classified 2 years after spraying as alive/healthy, alive/herbicide-damaged, or dead. At that time, the pines had been growing 4 years.

[6] *The author wishes to acknowledge the efforts of Ronald W. Sorensen, formerly Associate Silviculturist, North Central Forest Experiment Station, Grand Rapids, Minnesota, and now with the Minnesota Power and Light Company, Duluth, Minnesota, for his work in the mist blower experiment.*

[7] *Roe, Eugene I. Determining minimum amounts of herbicide needed for aerial brush control. Weeds 7: 178-183. 1959.*

Data summaries were transformed from percent to arcsin prior to one-way analysis of variance. Treatment means were analyzed by Duncan's New Multiple Range Test for significant differences at the 95-percent confidence level. All means presented here are transformed to percents from the arcsin means.

RESULTS AND DISCUSSION

Hazel control with mist blower. All treatments resulted in less than 2 percent survival of the aboveground stems of hazel 1 year following spraying (table 1). However, hazel resprouting was much less with Tordon 101 than with 2,4-D/2,4,5-T. Hazel treated with Tordon 101 had an average recovery after both 1 and 2 years of less than 10 percent, and in several plots resprouting amounted to less than 2 percent (fig. 1). In contrast, hazel treated with 2,4-D/2,4,5-T showed an average recovery of 26 percent after 2 years.

Figure 1. — *Hazel stand 2 years after mist blowing with 7.5 pounds ae Tordon 101 in 5 gallons total volume per acre. Hazel was virtually eliminated and grasses and sedges dominated the site. Note the untreated hazel in the background.*

Hazel resprouting did not differ significantly between plots treated with 5 gallons and 10 gallons of Tordon 101 per acre total volume. The average recovery of hazel following the more concentrated (5 gallons per acre) volume application was much less than it was following the higher volume applications, but differences were not significant due to the high variation among plots. The important result was that 2.5 pounds ae (acid equivalent) of Tordon 101 applied to foliage at a rate of 5 gallons per acre was significantly more effective in controlling sprouting of hazel than 2,4-D/2,4,5-T.

Brush control and conifer release by simulated aerial spraying. The August 1 treatments with 1 or 2 pounds of Tordon 101 ae per acre resulted in significantly less living crown of aspen suckers and mountain maple than those with 2 pounds ae of 2,4-D. For hazel, 0.5, 1, and 2 pounds of Tordon 101 ae per acre gave crown kills comparable to those in the mist blower study (table 2). Resprouting of hazel, however, averaged higher with these lower rates and was not significantly different from that obtained with 2,4-D. Mountain maple resprouting after all Tordon treatments averaged much less than after the 2,4-D treatment, although not significantly. The number of new suckers in aspen was low and unrelated to treatment.

The August 20 treatments gave much poorer crown kill of both hazel and aspen than the August 1 treatments, although living crown decreased with dosage rate. Resprouting was variable in hazel and aspen treated on August 20.

Red pine response to Tordon 101. Survival of red pine planted following mist-blower application of Tordon 101 did not differ significantly from survival following the 2,4-D/2,4,5,-T treatment (table 3). Overall survival was relatively low, but this was judged to be due to the heavy competition from grasses and sedges that dominated after the hazel was killed. Twisted or stunted needles and dead tops accounted for most of the damage to red pine. Damage was caused mostly by the overtopping vegetation rather than residual effects of picloram.

Table 3. — *Two-year survival of 2-1 red pine planted the spring following mist-blower herbicide treatment of hazel*

Chemical	Application rate	Total volume (chemical + water)	Percent survival	
			Healthy	Damaged
	(Pounds ae/acre)	(Gal./acre)		
Tordon 101	2.5	5	59	22
Tordon 101	2.5	10	45	31
Tordon 101	7.5	5	42	35
Tordon 101	7.5	10	27	25
2,4-D/2,4,5-T	4.0	5	44	15

Mortality and damage to red pine planted prior to simulated aerial spraying of Tordon 101 on August 1 increased markedly with the level of treatment, much more than on August 20 (table 4). Damage and mortality was attributed to picloram phytotoxicity. Red pine either browned out and died, usually in the year of spraying, or new needles were killed

Table 4. — *Survival of plantation red pine 2 years after simulated aerial release with herbicides on August 1 and August 20*

Chemical	Application rate	Percent survival	
		August 1	August 20
	Pounds ae/acre		
Tordon 101	0.25	100	100
Tordon 101	.50	100	100
Tordon 101	1.00	88	88
Tordon 101	2.00	50	88
2,4-D	2.00	100	100

or severely reflexed. No mortality or damage was found in red pines sprayed on either date with 2,4-D.

SUMMARY AND CONCLUSIONS

Tordon 101 was found to be superior to 2,4,-D/2,4,5-T mixture in controlling hazel by mist-blower application in early August. However, invasion by grass and sedge may hinder pine plantation establishment. Aerially applied Tordon 101 at rates of 1 or 2 pounds ae per acre resulted in significantly better top kill of aspen suckers and mountain maple than 2 pounds ae per acre of 2,4-D. For hazel, Tordon 101 at 0.5 to 2 pounds ae per acre gave top kill as good as 2,4-D at 2 pounds ae per acre. Control of aspen, hazel, and mountain maple resprouting by Tordon 101 was erratic, although it appears that Tordon 101 may inhibit resprouting of mountain maple. However, the resprouting results may have been confounded by the small size of the aerially sprayed plots, which allowed resprouting from roots originating outside the plots.

Although application of Tordon 101 gave acceptable kill of competing brush, only one treatment resulted in satisfactory survival of preplanted red pine. In plantations where hazel is the chief competitor, early August application of 0.5 to 1 pound ae Tordon 101 per acre gave more than 90 percent crown kill of hazel and about 90 percent survival of red pine. Research is needed, however, to determine whether mist blowing or helicopter rotorwash in plantation release work would cause more herbicide to come in contact with preplanted conifers. If so, even low application rates of Tordon 101 may be detrimental to red pine.

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PESTICIDE PRECAUTIONARY STATEMENT

This publication reports research involving pesticides. It does not contain recommendations for their use, nor does it imply that the uses discussed here have been registered. All uses of pesticides must be registered by appropriate State and/or Federal agencies before they can be recommended.

CAUTION: Pesticides can be injurious to humans, domestic animals, desirable plants, and fish or other wildlife — if they are not handled or applied properly. Use all pesticides selectively and carefully. Follow recommended practices for the disposal of surplus pesticides and pesticide containers.

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